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→ (71) Applicant (for all designated States except US): TENZING INC. [US/US]; 9845 Willows Road N.E., Redmond, WA 98073 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): BASTIAN, Fabio [AU/AU]; 7 Billargo Road, Westleigh, NSW 2120 (AU). GRESHAM, Simon, Isaac [AU/AU]; 95 Holdsworth Street, Wollahra, NSW 2025 (AU). LEMME, Peter, Wilfried [US/US]; 11233 N.E. 94th Street, Kirkland, WA 98033 (US).

(74) Agent: BALDWIN SHELSTON WATERS; 60 Margaret Street, Sydney, NSW 2000 (AU).

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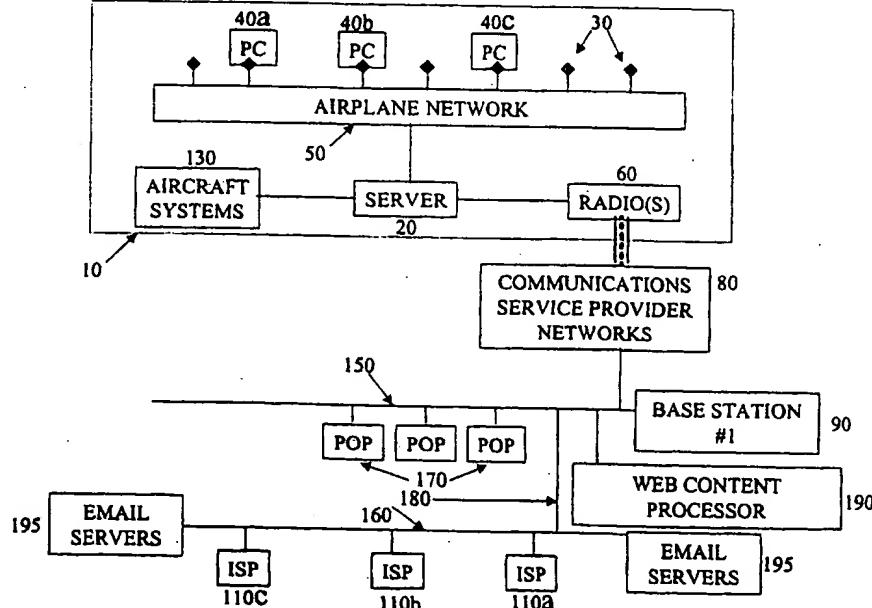
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(54) Title: COMMUNICATIONS SYSTEM FOR AIRCRAFT

## (57) Abstract

A system for permitting passengers on board an aircraft to send and receive electronic data is described. The components of the system on board the aircraft include a server (20) having a plurality of nodes (30) to which computer terminals (40a, 40b and 40c) are attached, as desired. The computer terminals are laptop or palm-top personal computers belonging to the various passengers on board. The server communicates with a wide variety of different terminals running different operating systems. Each computer terminal is connected to the server (20) via an aircraft network (50). Server (20) has mass storage which contains a database of WWW pages which can be browsed by passengers using terminals (40a, 40b and 40c). Server (20) provides a domain name server (DNS) that masquerades as the passenger's usual DNS. Server (20) then links the passenger to the appropriate locally stored WWW page. Server (20) also contains storage for Email messages. Connected to server (20) is one or more radios (60). This permits data to be transferred to base station (90) using communications network (80). A virtual private network (VPN) (150) connects station (90) to communications service provider networks (80), web content processor (190), and via links (180) to the Internet (160). Points of Presence (POP) (170) provide Internet access and Email service to subscribers of the service while not on the aircraft. POPs (170) can also be used by communications service provider networks and web content processors as an alternate means to connect to VPN (150).



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**TITLE: COMMUNICATIONS SYSTEMS FOR AIRCRAFT**Field of the Invention

The present invention relates to a communication system for aircraft and in particular to a system for transmitting electronic data between an aircraft and a terrestrial base station.

The invention has been developed primarily for use with passenger aircraft and will be described hereinafter with reference to that application. However, it will be appreciated that the invention is not limited to that particular field of use.

Background of the Invention

In recent times, portable computers such as "laptop" PCs and devices such as the Apple® Newton or other palm-held devices (PDAs) running Microsoft® Windows CE, for example, have become available. There have been commensurate improvements in mobile or cellular telephone technology and in protocols for transmitting computer-generated data across cellular networks. By employing a PCMCIA modem, for example, which allows data to be transferred between the laptop or PDA and mobile telephone, these twin developments have allowed e-mail messages and other electronic data to be sent and received by an individual at one of many locations, without the need to connect via a fixed land telephone line.

Several communications networks for providing telecommunications to airborne users are also known. For example, the North American Telephone System (NATS), including providers such as AT&T and Airfone, have installed terminals in many commercial aircraft to allow passengers to connect a laptop or PDA and transfer data from the passenger's seat.

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In addition to terrestrial based aeronautical communications, satellite service providers such as Inmarsat provide airborne passengers communications from virtually any global location. Similar services are also offered by Iridium, who has launched another network of satellites. Furthermore, other satellite providers have or are 5 launching constellations of satellites with the intention of providing airborne passenger communications.

One serious drawback of existing aeronautical passenger communications is the expense. In most cases, the passenger connects the laptop or PDA to a seat mounted handset using an integrated RJ11 jack. The passenger must make a modem connection 10 to their ground based access server, provide authentication information, and then retrieve or send data. This process is generally technically challenging and unreliable. Even for the transfer of small amounts of data, one or more calls of one or more minutes is necessary. Furthermore, the existing speed of transmission, defined as bits per second (bps), is relatively slow - for example, the INMARSAT satellite services currently limit 15 the data rate for passenger modem communications to 2400 bps. Thus, the time taken to transfer large amounts of electronic data, and the consequent expense, can become prohibitive.

In addition, the reliability of connection when employing a wireless link has been perceived as a major drawback during transmission of data in this way.

20 Thus, until now, the use of portable computers on aircraft, for sending and receiving electronic mail and browsing World Wide Web (WWW) sites has not been deemed feasible.

Disclosure of the Invention

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It is an object of the present invention to overcome or substantially ameliorate one or more of the disadvantages of the prior art, or at least to provide a useful alternative.

According to a first aspect of the invention there is provided a system for

- 5 transmitting electronic data between a computer terminal on an aircraft and a terrestrial base station, the system including:

a server mounted upon or within the aircraft for communicating with the computer terminal wherein the terminal is disposed remotely from the server; and

a terrestrial base station for selectively communicating with the server to allow

- 10 the data to be passed between the base station and the terminal.

Preferably, the base station communicates with the server via a link selected from one or a combination of: one or more wireless links; and one or more wire links. More preferably, the base station communicates with the server via one or more wireless links, each of those wireless links being selected from the group comprising: a satellite link; a cellular telephone link; a microwave link; a NATS compatible link; and another communication system. Even more preferably, the selection of the or each link is dependent upon one or more of: the availability of each link; the relative cost of each link; and the relative speed of each link.

- 20 Preferably also, the system includes a plurality of spaced apart terrestrial base stations and the server communicates selectively with one or more of the stations. More preferably, the base station with which the server selectively communicates is dependent upon the position of the aircraft with respect to the stations.

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In a preferred form, the server communicates with a plurality of remotely disposed computer terminals located on the aircraft for allowing communication of the electronic data between the base station and the respective terminals.

- Preferably, the terrestrial base station selectively communicates with an Internet service provider (ISP) to collect the electronic data and provide it to the terminal via the server.

More preferably, the data is communicated between the server and the terminal using one or more of: SMTP; HTTP; POP3; or IMAP. More preferably, the data is collected from the ISP and delivered to the base station using POP3 or IMAP.

- 10 In a preferred form, the base station includes means for providing a first signal indicative of the structure of the data and the terminal includes means for generating a second signal in response to the first signal confirming that the data is to be transmitted to the terminal. More preferably the first signal is indicative of one or more of the following: text; file type; attachments; graphics; backgrounds; and the like. Even more 15 preferably, the second signal confirms to the base station which portions of the data are to be transmitted.

- Preferably, the base station stores electronic data to be transmitted from the base station to the server, and the server stores electronic data to be transmitted from the server to the base station, the server and base station communicating with each other 20 intermittently.

In a preferred form, the server includes a database of information, the database being updated periodically by transmission of electronic data from the base station to the

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server. More preferably, the server allows the terminals to access the database. Even more preferably, the terminals access the database with a web browser.

Preferably also, the server communicates with that base station which is nearest to the aircraft. More preferably, the server determines which of the base stations is

- 5 nearest by determining the current location of the aircraft. More preferably, the server communicates with one only of the base stations. Alternatively, the server communicates with selectively with more than one of the base stations, the selection being made on the basis of the available remaining capacity of the respective base stations.

- 10 Preferably, the server communicates selectively with one of the base stations, the selection being made on the basis of the least expensive communication route that is made available by the respective base stations.

- 15 In a preferred form the computer terminal is suitable for either browsing the Internet or sending and retrieving Email. More preferably, the terminal is a portable personal computer. However, it is also preferred that the terminal is a PDA.

According to a second aspect of the invention there is provided a method for transmitting electronic data between a computer terminal on an aircraft and a terrestrial base station, the method including the steps of:

- 20 providing a server mounted upon or within the aircraft for communicating with the computer terminal wherein the terminal is disposed remotely from the server; and selectively communicating between a terrestrial base station and the server to allow the data to be passed between the base station and the terminal.

According to a third aspect of the invention there is provided an aircraft computer communication system including:

a first port and a second port located on the aircraft for allowing the establishment of a first network node and a second network node respectively; and

5 a network located on the aircraft for linking the first node and the second node and allowing communication between the first node and the second node.

Preferably, the network includes a telephone system and the second node is connected to the telephone system. More preferably, the second node is connected to the telephone system with a modem connection. Even more preferably, the first node is 10 connected to the telephone system with a CEPT-E1 connection. In a further preferred form the CEPT-E1 connection complies with an ARINC 746, attachment 11 radio bearer system interface.

Preferably also, the first and the second network nodes are a server and a computer terminal respectively.

15 According to a fourth aspect of the invention there is provided an aircraft computer network including:

a network hub located on an aircraft for allowing the transfer of first electronic data from the network to a base station;

20 a first port and a second port located on the aircraft for allowing the establishment of a first network node and a second network node respectively, wherein the nodes transfer respective second and third electronic data to the network via the hub such that the first data includes selected portions of the second data.

Preferably, the second data includes selected portions of the third data.

According to a fifth aspect of the invention there is provided an aircraft computer network including:

- a network hub located on an aircraft for allowing the transfer of first electronic data from a base station to the network;
- 5 a first port and a second port located on the aircraft for allowing the establishment of a first network node and a second network node respectively, wherein the network transfer respective second and third electronic data to the nodes via the hub such that the second data includes selected portions of the first data.

Preferably, the third data includes selected portions of the second data.

- 10 According to a seventh aspect of the invention there is provided a method of communicating on an aircraft, the method including the steps of:

- locating a first port and a second port on the aircraft for allowing the establishment of the first node and the second node respectively;
- locating a network on the aircraft for linking the first node and the second node
- 15 and allowing communication between the first node and the second node.

- Preferably, the network includes a telephone system and the second node is connected to the telephone system. More preferably, the second node is connected to the telephone system with a modem connection. Even more preferably, the first node is connected to the telephone system with a CEPT-E1 connection. In a further preferment,
- 20 the CEPT-E1 connection complies with an ARINC 746, attachment 11 radio bearer system interface.

Preferably also, the first and the second network nodes are a server and a computer terminal respectively.

According to an eighth aspect of the invention there is provided a method of communicating between a first node and a second node of an aircraft computer network, the method including the steps of:

- locating a network hub on an aircraft for allowing the transfer of first electronic  
5 data from the network to a base station;  
locating a first port and a second port on the aircraft for allowing the establishment of the first network node and the second network node respectively, wherein the nodes transfer respective second and third electronic data to the network via the hub such that the first data includes selected portions of the second data.

10 Preferably, the second data includes selected portions of the third data.

According to another aspect of the invention there is provided a method of communicating between a first node and a second node of an aircraft computer network, the method including the steps of:

- locating a network hub on an aircraft for allowing the transfer of first electronic  
15 data from a base station to the network;  
locating a first port and a second port on the aircraft for allowing the establishment of a first network node and a second network node respectively, wherein the network transfer respective second and third electronic data to the nodes via the hub such that the second data includes selected portions of the first data.

20 Preferably, the third data includes selected portions of the second data.

In the preferred embodiment each base station is capable to connecting to the Internet, and able to communicate with various Internet service providers and computing resources throughout the world. Thus, rather than each passenger on the aircraft

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- connecting individually via a satellite link, for example, to an Internet service provider, the passengers all connect to a central server on board the aircraft. This airborne server then establishes a connection a base station as necessary. Thus, the efficiency of data transmission between a passenger and their normal ISP may be improved, and the
- 5 overall cost of transmission to and from the aircraft may be significantly reduced.
- Further efficiency is gained by using compression software to reduce the quantity of data (bits) that needs to be sent between the airborne server and a base station. A Radius client interface is provided by the server/base station to interact with Radius servers for end user authentication and network access requests.
- 10 In one configuration, the server and the base station can store and forward requests; for example by a passenger to retrieve Email from their ISP's mail server. This may require the passenger's laptop to be connected for the duration of the data exchange between the airborne server and a base station, which can be restricted to 2400 bps or less. Furthermore, there may be no means to restrict or control the flow, for example, of
- 15 very large attachments.

- In another configuration, the server and base station can provide a proxy service, whereby, for example, the base station can retrieve Email on behalf of the passenger and transmit this information to the airborne server, and the airborne server can transmit passenger provided Email to the base station, in both cases, without the passenger's
- 20 laptop being connected to the aircraft network. The airborne server collects the Email and provides it to the passenger on demand. The aircraft network data rate is not necessarily restricted by the data rate of communications between the airborne server and a base station.

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The aircraft network may be comprised of a dedicated cables and circuitry between the server and dedicated ports in the seat. Alternatively, the aircraft network may be wholly comprised within an existing aircraft system, such as the airborne telephone system.

- 5       The system of the preferred embodiment thus provides for e-mail transmission and reception, for example, for a larger number of users, each having different Internet Service Providers which may in turn be in different countries.

- The protocol used for sending data from the or each remote computer terminal to the server, and from the server to the or each remote computer terminal, is preferably 10     FTP/TCP/UDP. Protocols supported by this connection include SMTP, HyperText Transfer Protocol (HTTP), POP3, IMAP and DNS.

- Preferably also, any data to be sent from the base station to the server is first analysed to determine its structure (unlike store and forward principals). Most 15     preferably, the base station sends to the server structure data indicative of the structure, the structure data being then communicated to a predetermined one of the remote computer terminals. This technique prevents large attachments, for example, to e-mail messages from being sent across the relatively low bandwidth link between the base station and the server, other than where the relevant passenger agrees to pay a nominated fee. That is, upon being informed of the data structure, the user of the remote terminal 20     within the aircraft is provided with the choice as to whether the attachment need be obtained. The passenger can interact with the server through the use of server generated web pages.

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Preferably, the base station is arranged to store electronic data to be transmitted from the base station to the server, and the server is arranged to store electronic data to be transmitted from the server to the base station, the server and base station communicating with each other intermittently.

5 To minimise cost and improve efficiency, the server and base station preferably each store electronic data as they receive it from the individual users on the plane and their Internet service providers respectively. In one embodiment, a connection is then made intermittently. During each connection, data is exchanged between the server and base station, and after exchange has been completed, the connection is terminated. For  
10 example, in one embodiment the server and base station exchange data for one minute or so, every fifteen minutes. Compression software is used to minimise data transfer.

In one preferred form the system includes a plurality of base stations. For example, each Continent may have a separate base station. The server preferably connects with that base station which it is nearest to at a given time. In other  
15 embodiments, however, a single base station is utilised.

The server also preferably acts as a virtual WWW. For example, in one embodiment the server stores a plurality of pages of information from a number of web sites. Because this information is stored on board the aircraft, it may be accessed very rapidly and without significant communications expense. The server necessarily  
20 redirects the passenger browser to appropriate web pages available locally.

The external link, however, allows updating of the stored pages from time to time. Most preferably, the web pages are stored in a cache which is updatable

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differentially. That is, as changes to a particular web page are effected, only the new or amended parts of each page need be sent via the wireless link, rather than the full page.

Preferably, the server includes a mass storage device which is updated to the latest available content prior to departure of the aircraft from a port of call.

5        Preferably also, the passenger establishes a PPP connection between the remote computer terminal and the server, normally using a specially provided dialer application. In other embodiments, however, the dialer application is manually configured. Even more preferably, the server captures the passenger Email account information (user identification and password) to be used by a Radius client for user authentication against  
10      a Radius server.

The base station preferably receives authentication from a Radius server, delivering Email from the passenger and retrieving the passengers Email from the passengers Email server. More preferably, the base station provides the passenger Email to the server, with indications of any additional attachments and the base station provides  
15      any passenger instant messaging, which will be delivered to the passenger's terminal and displayed using a resident application, such as the dialer. Even more preferably, the server provides the Email to the passenger Email client with the passenger subsequently retrieves Email. Further preferments include interacting the passenger and the server to determine if any additional attachments should be retrieved and, if so, retrieving the  
20      attachments from the base station.

Preferably, the passenger browses the world wide web content provided by the server.

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In a preferred form, the server/base station use Simple Network Management Protocol (SNMP) for network monitoring.

Preferably also, the server and base station maintain accounting of all transactions for billing purposes. Preferably also, the server and base station monitor 5 passenger activities and recording these activities for other uses. More preferably the server and base station determine when to cease retrieving Email on behalf of the passenger and when to restore any undelivered Email.

It will be understood that preferred features of this method may correspond to the preferred features of the system of the present invention.

10 Unless the context clearly requires otherwise, throughout the description and the claims, the words 'comprise', 'comprising', and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to".

#### Brief Description of the Drawings

15 Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a schematic overview of a system according to the present invention;

Figure 2 is a schematic sectional view of a part of an aircraft;

Figure 3 is a flow diagram illustrating the protocols for transferring Email or

20 other data from the aircraft;

Figures 4 is a flow diagram illustrating the protocols for transferring Email or other data to the aircraft;

Figure 5 is a schematic view of an alternative system according to the invention;

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Figure 6 is a schematic representation of the interaction of an aircraft and the terrestrial part of the system of Figure 5 as it travels from a point of departure to a destination;

5      Figure 7 is a block diagram of an aircraft network according to another aspect of the invention;

Figure 8 is a block diagram of an alternative aircraft network according to the invention; and

Figure 9 is a block diagram of a further alternative aircraft network according to the invention.

10    Preferred Embodiment of the Invention

Referring to Figure 1, a system for permitting passengers on board an aircraft to send and receive electronic data is shown. Those parts of the system located on board the aircraft are shown within the region bounded by broken lines and labelled 10 in Figure 1. The components of the system on board the aircraft include a server 20 having  
15    a plurality of nodes 30 to which computer terminals 40a, 40b and 40c are attached, as desired. The computer terminals in the embodiment shown are laptop or palm-top personal computers belonging to the various passengers on board. As will be explained below, the server communicates with a wide variety of different terminals running different operating systems. Each computer terminal is connected to the server 20 via an  
20    aircraft network 50.

The server 20 has mass storage which contains a database of WWW pages which can be browsed by passengers using their computer terminals 40a, 40b and 40c. Server 20 provides a domain name server (DNS) that masquerades as the passenger's

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usual DNS. Server 20 then links the passenger to the appropriate locally stored WWW page.

The server 20 also contains storage for Email messages.

- Connected to the server 20 is one or more radios 60. This permits data to be  
5 transferred to base station 90, using communications networks 80.

- A virtual private network (VPN) 150 connects base station 90 to communications service provider networks 80, web content processor 190, and via links 180 to the Internet 160. Points of Presence (POP) 170 provide Internet access and Email service to subscribers of the service while not on the aircraft. POPs 170 can also be used by  
10 communications service provider networks and web content processors as an alternate means to connect to VPN 150.

Base station 90 connects to Internet service provider (ISP) 110a, 110b and 110c, which are the ISP's of the respective passengers on board the aircraft who are connected to server 20 and have the Email servers for each respective passenger.

- 15 Thus electronic mail sent from terminal 40a on board the aircraft is first forwarded to server 20 where it is stored. The server determines the appropriate time to initiate a data exchange with station 90. This can be when sufficient data is awaiting transmission from server 20, or when the time since the last exchange exceeds a time limit (15 minutes), or when station 90 signals to server 20 via communications service  
20 provider network 80 and radio 60. Any e-mail messages stored on server 20 since the previous connection was made are then transmitted to station 90. Station 90 forwards the or each e-mail message on to their eventual destinations Email servers 195.

Similarly, any messages generated by the user of terminal 40b are also sent to server 20 for storage, and forwarded to station 90 along with the stored messages from the other passengers. The station 90 then forwards messages from the computer terminal 40b on to their eventual destinations as well.

- 5        The general procedure for obtaining e-mail messages from the Internet service providers of the various passengers is similar to the procedure for sending e-mail messages from the various terminals 40a, 40b, 40c on the aircraft. Once a passenger connects a PC to aircraft network 50 and then connects to server 20, the passenger initiates Email retrieval. Server 20 accepts the request for Email and collects the
- 10      passenger Email user id and password. This information is passed to base station 90 via radio 60 and communications service provider networks 80. Base station 90 contacts ISPs 110a,b,c and collects any Email for the passengers using their user IDs and passwords. Base station 90 continues to collect Email from ISPs 110a,b,c for the duration of the flight that the passengers are on. When a connection is established
- 15      between server 20 on board the aircraft and station 90, that stored e-mail message or messages are transmitted from station 90 to server 20. This procedure is usually simultaneous with the transmission of e-mail messages in the other direction from server 20 to station 90.

- Once e-mail messages have been received at server 20, they are retrieved by the
- 20      respective passenger's computer terminals, 40a and 40b via the aircraft network 50 when the passenger subsequently connects to server 20 and retrieves mail.

The system includes a single base station. However, in other embodiments, such as that illustrated in Figure 5, the system includes a number of base stations located at spaced apart locations on the surface of the planet.

Returning to the system of Figure 1, as the aircraft flies from its departure airport 5 towards the destination airport, aircraft system 130 indicates to server 20 the location of the aircraft at regular intervals.

Having provided a brief overview of the system, a detailed description of the software and hardware of the system will now be provided with reference to the Figures 2, 3 and 4.

10 Referring to Figure 2, a section through an aircraft fuselage is shown schematically at 200. Features common to Figures 1 and 2 are labelled with like reference numerals.

The part of the system on board the aircraft comprises server 20, mounted within a hold 210 of the aircraft. In other embodiments server 20 is mounted elsewhere within 15 the aircraft. In the specific embodiment described, however, this server is configured to provide proxy Internet services. Such a server is capable of acting both as a server and as an Internet gateway. As described in connection with Figure 1, the server is connected to the aircraft network 50, to the aircraft systems 130, and is connected to radios 60.

20 A PPP connection is made between each passenger's portable computer (such as 40b) and server 20. When a passenger wishes to connect to server 20 from his or her portable computer 40b, a cable 290 is used. In one embodiment, one end of cable 290 is inserted into the serial RS-232 port of the portable computer, and the other end thereof is

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plugged into the socket in the armrest 230. In other embodiments other cabling and connector combinations are utilised, such as connections to the Universal Serial Bus, or the PC modem. In any event, at this point, a hardware connection has been made between the individual portable computer 40b and aircraft network 50.

5 Preferably, the connection from aircraft network 50 includes the provision of power to the portable computers or other devices so that they need not run on battery power alone. In some embodiments, however, a power supply socket is provided in armrest 230 as well.

The software requirements for connecting to server 20 will now be described. It  
10 will be understood that the system is designed to permit access by many different types of portable computer, such as a "laptop" personal computer, a palm-top computer (PDA) running the Microsoft® Windows CE operating system, the Apple® Newton notebook or any other portable device, and the term "remote computer terminal" is to be construed accordingly. It will also be appreciated that this term is also intended to encompass any  
15 electronic device which is capable of PPP communication. The desirability of allowing different platforms to connect to the server is why a PPP connection between the computer and the server is preferred. PPP connections allow Point-to-Point Protocol (PPP) transmissions between the computer and server, PPP not being limited to carrying TCP/IP traffic and being capable of piggy-backing other network protocols such as IPX,

20 SPX and AppleTalk.

Preferably installer software is provided to each user of the system. More preferably the installer software is obtainable from one or more of the following sources: pre-flight access to an Internet site; pre-flight e-mail; floppy disk; or any other suitable

means. Typically different installer software will be required for use with different operating systems. In use, the installer software is executed by the passenger either during or prior to the flight. The software adds a new PPP service. The details of how such a PPP service is added will vary between different operating systems, but will be 5 familiar to those skilled in the art. In circumstances where the installer software is provided inflight, the software, once loaded into the passenger's terminal, changes the dial-up networking settings as required and starts the PPP service.

Internet client applications such as HTML browsers and e-mail applications subsequently started by the passenger then obtain Internet services from server 20 over 10 the PPP service.

It will be appreciated that a user could manually carry out the setting up of a new PPP connection, instead of obtaining and running the installer software which automatically does this for the user.

After the passenger disembarks from the aircraft after their flight, the next time 15 they attempt to connect to their ISP via a standard Public Switched Telephone Network (PSTN) connection, for example, the relevant network settings are still available on their computer. A dialer program will automatically configure the passenger's computer for local dial-up using a global roaming ISP dial up POP service.

Server 20 is configured to provide proxy Internet services to the passengers' 20 computers. For example, an HTTP request from a passenger's computer for an HTML page is received by server 20, which recovers the requested HTML page, if available, from its cache. The HTML page is sent to the passenger's computer which need not be aware that the page has not been sent directly from the remote WWW site. Similarly,

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the server 20 responds to IMAP, POP3 or SMTP requests from a passenger's computer as if it were the passenger's normal ISP, by exchanging e-mail from the base station via the server 20. Thus, the proxy configuration of the server 20 means that the passenger's computer appears to be connecting directly to remote Internet services. The passenger

- 5 informs the server 20 of their e-mail address and ISP details; this information may be automatically downloaded from the passenger's computer to the server the first time the passenger's e-mail system attempts to retrieve mail without any additional or unique action on the part of the passenger.

With the above software and hardware arrangement, a data rate up to the

- 10 maximum speed of the passengers computer port is possible, with a very large number of separate connections to the server being possible. In practice, of course, there are typically only 300 or so seats on an aircraft, and the server therefore only ever needs a maximum of that many connections. In embodiments making use of modem, serial port, USB and IEEE 1394 the provided data rates are in the order of 56 kbps, 115.2 kbps, 12
- 15 Mbps and 400 Mbps respectively. Attachment 1 describes several aircraft network embodiments.

Furthermore, whilst the hardware and software connections between the server and the passenger's computer have been described in terms of PPP connections, it will be understood that ethernet connections are equally possible. Nonetheless, having

- 20 understood the function of the software operating on the passenger's computer, the skilled person will have no difficulty in implementing a similar program for ethernet connection between that computer and the server. In particular, the system registry settings of a passenger's computer will need to be changed for the duration of the flight

to reflect the fact that the passenger's computer is to be connected to a DNS gateway different to that which the passenger would normally use. The settings can be adjusted automatically by the software, and then automatically reset when the flight terminates and the passenger shuts down his computer.

- 5        In addition to acting as an SMTP/POP3/IMAP gateway for sending and receiving e-mail messages to and from a passenger's ISP on the ground, the server additionally acts as a local WWW site. In particular, the server includes a large cache which contains mirrors of a variety of WWW sites. These are loaded into the cache either by remote connection, to be described below, or by physically replacing the cache whilst the  
10      aircraft is at an airport.

- For the preferred server described above, a cache containing a multitude of WWW pages can be stored, in addition to audio and video data, to replicate a virtual world wide web environment. Differential Management of Proxy Cache (DMPC) may be used. This allows very large collections of WWW pages to be updated and deleted on  
15      the basis of the changes to the code (HTML) within each page, without having to reload all of each page when updating the cache. When the cache is first loaded, DMPC also allows a predetermined number of levels, such as three, within a particular web site to be downloaded to the cache automatically. However, in other embodiments a different number of levels are downloaded. Where three layers are stored each separate site  
20      mirror stored in the cache on the server contains the "home page", the first layer of pages referred to in the home page, and the second layer of pages referred to in the first layer of pages.

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DMPC, or other processes, also removes any HTML code from the WWW sites downloaded into the cache, where that code would otherwise attempt to generate a hyperlink to a site that does not exist on the cache. Thus, there is no possibility for a passenger browsing the pages within the cache on board the aircraft to visit Internet sites which have not been stored in the cache.

Although the passenger's computer is therefore only accessing a "virtual" worldwide web, consisting of the pages of information stored in the cache, the server provides the information in a standard WWW form. Thus, each passenger can use their normal web "browser" to access the information stored in the cache as if they were accessing the original web site itself. As an option, the cache may also contain a search engine to allow those pages of interest to a passenger to be located.

In one preferred embodiment, the server provides a search engine that references the URL of any pages contained on the server. In the event that the exact page is not found the search engine will conduct additional searching of the other URL's to determine whether there are any that appear similar in meaning to that one requested.

Once obtained, the results of the search are provided to the passenger for viewing.

Results of searches that are not matched may be used for updating the cache.

As previously mentioned, the cache can be updated in two different ways. The quickest method is for the cache to be updated directly from a cache drive which is brought on board the aircraft. At major airports, a Terrestrial Control Unit or TCU will be available for updating web-site content on a server. At any particular time, a TCU will contain updated web content for the sites that are contained on the server. When a aircraft arrives at a particular airport, updating the web cache simply involves

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transferring the updated information from the TCU to the server on an aircraft via an appropriate medium, which will most likely be hot swappable hard drives. The server is switched on and a physical connection is made between the cache drive containing the data for updating the cache within the server. Preferably, the updating takes place via

5 DMPC.

An alternative method of updating the cache is from the TCU closest to the arrival airport. In this embodiment this is achieved by updating from the TCU via a wireless local area network (LAN) once the aircraft has landed. Some airports now have LANs which allow connection via wireless link such as "Gatelink" and high speed LAN link cable. Thus, as the aircraft arrives at the airport, the server can be configured to connect via this link to the airport LAN. Once a connection between the server on board the aircraft and the LAN hub has been established, the latter can connect in turn to the closest TCU to obtain updates for the cache within the server on board the aircraft. As with the method of updating using a cache drive, the cache is updated using DMPC to

10 minimise updating time.

15

In some cases the links are other than those specified above and the server is configured to utilise these links, as required.

Another alternative, although more limited in application, is to update the cache during flight.

20 The connection between server 20 and station 90 is best illustrated in Figure 1 and will now be described in more detail. As passengers upon the aircraft compose and send e-mail messages, those messages are passed to server 20 which stores them in a dedicated region of the cache. Simultaneously, e-mail messages sent from outside the

aircraft and intended for passengers on board that aircraft accrue in a memory within the station 90.

The transmission is carried between the server and the base station using standard protocols (TCP/IP/PPP) or on a protocol known as ANETP. This protocol has been developed to address the perceived problems with wireless (satellite) connections between the server on board the aircraft, and a base station. The data is transferred in a compressed form using blocks, between two systems that are linked via serial data connection or via a TCP/IP compliant connection.

Server 20 controls the connection to the station 90. At, for example 15-minute intervals, the server connects to the base station. The server provides the station 90 with a session i.d. and the number of blocks it is about to transfer together with the size of these blocks. Simultaneously, the station 90 confirms with server 20 the number and size of blocks to be transferred. The block size determined by server 20 may be overruled by the base station, which determines the speed and reliability of the link.

Once confirmation is given, server 20 transfers block #1 to the station 90. If this transfer is successful the base station responds with an OK signal. This process continues until all blocks have been sent, or the connection fails or times out. This same process takes place for sending data from the base station to the server, in one embodiment, simultaneously in both directions.

If the data stream is broken, the server restores the connection from the next block after the last block successfully acknowledged as received was sent.

Further details of the ANETP protocol may be found in Appendix 1.

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The INMARSAT telecommunications satellite is used in some embodiments for transferring data. However, this only transfers analogue signals at between 2,400 and 4,800 bits per second. However, low and medium earth orbit communication satellites have recently been launched, such as those offered by Globalstar and Iridium. These 5 satellites substantially increase the available bandwidth for the server to base station link.

The communications link remains active until the server has delivered each of the messages waiting to station 90, and station 90 has also delivered each of its stored e-mail messages to server 20. When the server detects that the data transfers are complete, it 10 terminates the communications session with the base station. From that point, any e-mail messages received at server 20 from the passengers' computers are stored in the cache of server 20 until the next connection to the base station is made. Similarly, e-mail messages at station 90 are stored there until the next connection.

In addition to transferring e-mail message data, the communications links (when 15 connected) also transfers web site updates during the flight. Because of the relatively low bandwidth of the existing communications links, large scale updating of web pages stored in the cache on server 20 is not practical. Small amounts of information, perhaps relating to share prices, weather updates and news flashes can be provided with a minimal amount of data being transmitted. Thus, each time, a connection is made to 20 exchange e-mail messages, such updates can also be exchanged. The ANETP protocol used for transferring data between the server and a base station may dynamically assign the bandwidth available during each connection.

Station 90 is arranged to connect to the ISPs of the various passengers on board the aircraft. Typically, a normal Internet connection 180 from network 150, as will be familiar to those skilled in the art, is used. Certain ISPs, however, allow only dial-up connections, and in that case it is preferable to employ the Secure Socket Layer (SSL)

- 5 protocol to allow authentication of a base station by the ISP. Mail sent to the passengers on board the aircraft will, of course, initially be sent to the mailbox at the passenger's ISP. The system described above fetches the mail from the mailbox at the passenger's ISP and forwards it to the passenger's computer on the aircraft via station 90 and server 20. Likewise, messages sent from the aircraft will travel first to the base station, before 10 proceeding on to their destination. In that case, there is no need for the e-mail messages to be routed via the passenger's ISP. As will be explained in further detail in Figure 3 below, the SMTP protocol is used for forwarding e-mail messages from a base station and it is this protocol which will decide the route to the eventual destination.

- As also shown in Figure 1, station 90 connects via VPN 150 to web content 15 processor 190 for the purposes of updating the cache in server 20. Once the updated pages are stored at station 90, they are either transferred via communications network 80

- In another embodiment of the invention more than one base station is used for the intelligent management of e-mail information between an aircraft and the Internet. Each 20 base station is identical in specification and also the information they hold. This enables the aircraft to connect to any base station and find the pertinent information for the aircraft ready for retrieval. Each base station has connections to VPN 50, providing a means for receiving connections from any airborne server, communicate with other base

stations/web content processors, and links to the Internet for retrieving/sending customers' information

The method by which e-mail messages are sent from passenger's computers on the aircraft to their destination, and the method of receipt of e-mail messages by the

- 5 passengers' computers on the aircraft from their respective ISPs, will now be described with reference to Figure 3 and 4.

There is a very high bandwidth connection possible between each passenger's computer and server 20, and a potentially high bandwidth between station 90 and its eventual destination or passenger ISP. However, the bandwidth of the connection

- 10 between server 20 and station 90 is typically an order of magnitude or more slower. The well-known SMTP protocol was developed for slow but permanent connections between machines on networks. The connection between server 20 and station 90 is, in contrast, both slow and non-permanent. An important feature of the system is that the connection time is relatively short, to minimise communications costs. During a short connection  
15 time, it is important to recognise that the negotiation or hand-shaking protocols and so forth will take up a relatively large percentage of the total connection time.

Server 20 receives e-mail messages from each passenger's computer 40a, 40b and 40c. In Figure 3, the SMTP protocol only is shown. This is used because any computer with a browser will handle this protocol. However, it will be understood that  
20 other protocols such as HTTP are suitable depending upon the system requirements, as will be familiar to those skilled in the art.

Messages in Internet mail format are stored in server 20. When a connection is made between server 20 and station 90, the e-mail messages are sent via a protocol

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which addresses the low bandwidth and short communication time of the satellite connection. Specifically, the protocol (ANETP) which carries the Internet e-mail messages includes a number of compression systems to allow for greater bandwidth and management of dropouts during the time in which server 20 is connected to station 90.

5 For example, depending upon the size of files to be transferred, negotiations are carried out. Once station 90 has received the e-mail messages, it forwards them on to the various destinations using SMTP. The manner in which the information is passed from the base station to the various destinations is entirely standard and will be familiar to those skilled in the art.

10 Referring now to Figure 4, the method by which e-mail messages are received from a passenger's ISP to his or her computer on board the aircraft is shown.

POP3 and IMAP are Internet standards for transferring mail from mailboxes at customer ISPs to that customer's computer. The details of these protocols will be well known to those skilled in the art, and further details may be found in the RFCs.

15 While POP3 is acceptable for passing the messages to base station 90, it has several limitations which mean that its use is not preferred for transfer of information between a base station and the server. Specifically, POP3 does not allow message descriptions, and attachments to e-mail messages (such as graphic images and the like) are simply sent as encrypted, uncompressed text messages. The attachments can therefore be extremely

20 large and even on a standard dial-up connection between a computer and an ISP, with a transfer speed of 28.8 kbaud, data transfer can take several minutes. Thus, a separate protocol (ANETP) is used for transferring mail between the base station and server 20.

A method called Intelligent Mail Management (IMM) is used to manage the collection

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and delivery of emails including the management of any attachments to the emails. The IMM protocol analyses e-mail messages to identify the various components of the message.

For example, if an e-mail includes a text message and two attachments, the first having a size of 4 Mb and the second having a size of 6 Mb, these components are

- 5 identified to server 20. It may be, of course, impractical to send these very large attachments via the slow communications links. Thus, the IMM method simply sends a summary of the e-mail received at the base station from the passenger's ISP to the server on board the aircraft, together with the text part of the message. Once this has been received by server 20, it is forwarded to the specified passenger, again using either the
- 10 HTTP protocol, the POP3 protocol or any other suitable protocol.

When a passenger receives an e-mail message using this system, he or she receives the text message and an indication of any attachments to the original e-mail message. These attachments are only sent to the passenger on board the aircraft upon the passenger agreeing to pay a nominated fee. In one embodiment, the passenger interacts with server 20 by utilising a hyperlink in the received message leading to a private interactive web page hosted by server 20, providing an on-line means for the passenger to control the delivery of attachments. Alternatively, the passenger can defer delivery of large attachments until the passenger has left the aircraft and established an alternative connection to the relevant ISP.

- 15 20 A potential problem arises when a passenger logs onto server 20, thus triggering the system to collect any waiting e-mail messages from his mailbox at the ISP, but does not retrieve some messages subsequently collected by base station 90 and stored in server 20 before leaving the flight. Copies of Email retrieved by base station 90 may be

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retained at the originating mail server; they are not necessarily deleted when retrieved by base station 90. After the flight, the passenger will connect to the originating mail server through whatever means and these messages may still available for download. Some mail clients will detect those messages that have been already received and will

- 5 automatically delete the duplicates from the originating mail server without necessarily downloading them. In one embodiment, Email that is not delivered to the passenger is resent to or retained by base station 90 and then subsequently resent to the passenger's Email account as a new Internet Email message. Base station 90 can format the resent message to appear virtually identical to the original message without regard to mail
- 10 server capabilities.

Server 20 and base station 90 coordinate the registration of passengers such that Email is retrieved optimally for the duration of a flight. By monitoring aircraft system parameters such as passenger doors open/closed and whether the aircraft is airborne or on the ground, server 20 determines the appropriate time for base station 90 to cease

- 15 retrieval of Email for that set of passengers on that particular flight. Base station 90 incorporates additional monitors to recover from the loss of communications with a particular server 20. Server 20 can detect unusual events, such as cancelling a flight without leaving the gate, return to gate without taking off, and holding short of the destination gate for extended periods of time, and provide the optimum level of service
- 20 for the particular situation. For example, Email retrieval from base station 90 may cease when the doors open at the destination gate, while server 20 is obliged to provide any Email already retrieved from base station 90 to a passenger's laptop for as long a period of time that is practical, for example 20 minutes after door s open.

The operating system of the preferred server also continually monitors all of the primary services provided by the server. If errors occur then the system automatically re-boots. However, remote diagnosis of faults on the server is also possible using the communications link with the base station 90. SNMP is used for network monitoring.

- 5       The aircraft network 50 provides additional advantages. Passengers may communicate with one another using the network, or with airline crew to request assistance, for example. The server, in some embodiments is also configured to provide audio and video images to the passengers. Currently, some aircraft provide a screen (in the back of the seat in front of the passenger), and audio sockets in that passenger's
- 10      armrest. A relatively small selection of audio and/or video programs are selectable by the passenger. Using the present system, provided that a passenger has a portable computer with audio/video capabilities, that is, a sound card and MPEG driver, then a very large quantity of audio/video entertainment can be provided. The very high data transfer rate possible on board the aircraft, when data does not have to be received from
- 15      the ground, and the large amount of storage space on the server, permits, for example, MPEG movies to be viewed or games to be played.

- Another embodiment of the invention is illustrated in Figure 5 and Figure 6. More particularly, in this embodiment, use is made of a plurality of like spaced apart base stations. For ease of illustration only a second base-station 120 is shown. It will be  
20      appreciated, however, that in this embodiment three such stations are used. In other embodiments more than three base stations are used.

Rather than communicating with any one of the base stations, server 20 communicates with that base station to which it is closest to at the time. The technique

by which the aircraft connects to a base station, and in particular how hand-over between a first base station 90 and a second base station 120 takes place, will now be described in more detail with reference to Figure 5 and Figure 6. The planet is divided up into regions 400, 410 with a region of overlap 420 between them. Figure 4 only shows two 5 such base stations 90, 120 and their respective cells 400, 410. However, in practice, a number of base stations will be provided around the planet at suitable locations. For example, base stations may be provided in Western Europe, North America, South America, South East Asia, Southern Africa and Australia. The size of each cell will, of course, depend upon the total number of base stations provided, so that the main airline 10 routes are covered. In one preferred embodiment of the invention only three base stations are utilised, one in the UK, one in the USA and one in Australia.

An aircraft flying from London to New York will connect over the initial part of its flight to the first base station 90 located, for example, in the Republic of Ireland. Station 90 is used when the aircraft is stationary at the point of embarkation. While the 15 aircraft is being cleaned and refuelled, the wireless connection to the airport LAN is made, or the cache drive is supplied, to update the cache within server 20. Once the aircraft leaves the airport in London, all communications are made via communications service provider networks 80 to base station 90. At position A shown in Figure 6, for example, the aircraft is still within the first cell 400 and communicates solely with 20 station 90. The aircraft is able to track its own position using aircraft system 130. Each time the aircraft connects to station 90, in addition to exchanging data carrying e-mail messages and cache updates, it also informs station 90 of its position

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Each base station is pre-programmed with its coverage area. Thus, when the aircraft enters the transition area between two cells, station 90 commands server 20 to contact station 120 for subsequent serves upon the completion of the next data exchange with server 20. Station 90 then contacts station 120 via VPN 150 and provides the 5 necessary information for station 120 to continue to provide service.

- The aircraft initiates communications and continues to communicate with station 120, which now carries out the various functions previously carried by station 90, such as downloading information from various Internet sites so that the cache in server 20 can be updated, and connecting to the passenger's ISPs to retrieve e-mail messages. The 10 second base station preferably provides different information to the first base station. For example, when the cache is updated during the flight, news, weather and so forth for the geographical area surrounding station 120 is provided instead. Passengers travelling from London to New York can accordingly receive both up-to-date and relevant information throughout the flight.
- 15 Under some circumstances, it is possible server 20 will inadvertently contact the wrong base station. While server 20 should retain necessary information in non volatile memory to recover gracefully from a reset condition, all base stations will respond to server 20 with the necessary information to contact the correct base station, using VPN 150. In one embodiment, certain passenger configuration information is retained at the 20 base station to enable server 20 to recover from a reset condition without interrupting service or necessitating all passengers re-register for service.

Aircraft network 50 provides a set of connection points 30 that provide a means to communicate between server 20 and each passenger terminal 40A, 40B, 40C. A typical terminal may have one or more of the following interfaces available:

1. Modem
- 5 2. RS232 Serial Port
3. Universal Serial Bus (USB)
4. IEEE 1394
5. Ethernet Port

The aircraft network may support one or more of the above interfaces.

10 Exemplary characteristics for such networks are described below with reference to Figures 7, 8 and 9. More particularly, Figure 7 illustrates a modem network interface that allows the passenger to connect their modem to a telephone mounted such that access is available from their seat. In many cases, only one phone is available for each three passengers. It is typical that a dedicated phone is available to passengers flying in  
15 premium seats.

Airborne telephone networks generally follow the guidance of ARINC 746, "Cabin Communications Systems", and ARINC 628, "Cabin Equipment Interfaces".

A Cabin Telecommunications Unit (CTU) 65 provides a telephone switching capability between the Cabin Distribution System (CDS) 67 (which provides the  
20 telephones in the cabin) and the radios 60 that provide air ground telephone service. The interface from the CDS 67 to the CTU 65 is described in ARINC 746, attachment 17, although many configurations are not completely compliant with this definition. The interface from the CTU 65 to the air ground radios 60 is described in ARINC 746,

attachment 11. Most CTUs and radios comply with this specification, and are interchangeable.

Network 50 provides an interface to the CTU 65 such that server 20 appears to be an air ground radio to the CTU 65. The CTU 65 routes calls to server 20 in a manner 5 identical to the way the CTU 65 routes telephone calls to the other air ground radios 60.

The handset 30 generally provides an RJ11 jack to provide a two wire interface to the passenger modem. The passenger configures their PPP dial up networking to call a special phone number allocated for this service. The passenger connects their terminal 40A to the telephone handset 30 and initiates the telephone call. The CTU 65 routes this 10 call request to server 20 based on the phone number that is being dialled by the passenger terminal 40A (and does not route the call to the air ground radios 60).

The server 20 terminates each call request into an internal modem bank. This allows the passenger modem and the server modem to communicate at data rates as high as 56 kbps using an existing cabin telephone system, given minimal configuration 15 changes to the CTU.

An alternative interface is an RS232 port, which is illustrated in Figure 8. Such an interface is available on many passenger terminals and can provide data rates as high as 115 kbps. Accordingly, the aircraft network 50 shown in Figure 8 provides a jack 30 which allows the passenger to connect their RS232 port from their seat. The jack 30 is 20 connected to a dedicated Cabin Distribution Network 69, which provides a communications path to server 20. The passenger terminal 40A is configured to utilise the serial port and establishes a PPP connection with server 20.

Some passenger terminals will support a USB connection, with data rates as high 12 Mbps. The aircraft network 50 shown in figure 8 provides a jack 30, which allows the passenger to connect their USB port from their seat. The jack 30 is connected to a dedicated Cabin Distribution Network 69, which provides a communications path to 5 server 20. The passenger terminal 40A is configured to utilise the USB port and establishes a PPP connection with server 20.

Some passenger terminals will support an IEEE 1394 connection, with data rates as high 400 Mbps. The aircraft network 50 shown in Figure 8 provides a jack 30, which allows the passenger to connect their IEEE 1394 port from their seat. The jack 30 is 10 connected to a dedicated Cabin Distribution Network 69, which provides a communications path to server 20. The passenger terminal 40A is configured to utilise the IEEE 1394 port and establishes a PPP connection with server 20.

Some passenger terminals will support an Ethernet interface, with data rates as high as 100 Mbps. The passenger terminal can be connected to the aircraft network as 15 shown in Figure 9. Typically, the interface uses an RJ45 jack connected into an Ethernet Hub. The Hub(s) provide IP networking services between the passenger terminal 40A and the server 20. This aircraft network is well known to one familiar in the art.

The various protocols referred to in this specification, unless otherwise indicated, are all industry standards. Full details of these standards may be obtained from various 20 sources as will be known by those skilled in the art.

Preferred embodiments of the invention offer many and varied advantages and improvements over the prior art systems. By way of example, the following advantages are achieved:

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1. A plurality of users are cost effectively bundled together for communication with a single ground station;
2. Email being sent to the user during the flight is stored on the onboard server notwithstanding that the actual user is not logged onto that server at the time;
- 5      3. Use can be made of any ISP and any communication protocol;
4. An email message to the user will include a hypertext link for any attachments.

Should the user wish to access the attachments they will be linked to a private web page which allows retrieval of that attachment;

5. The homepages on the onboard server will masquerade as the actual homepages;
6. Differential updating of onboard web pages; and
7. The user's email name and password are captured and utilised such that the user does not have to have these re-entered during the establishment of the intermittent communication between the base station and the onboard server.

15      Although the invention has been described with reference to a specific example it will be appreciated by those skilled in the art that it may be embodied in many other forms.

### Appendix 1

#### AirNet Enhanced Transfer Protocol (ANETP/1.0)

This appendix is designed as the preliminary specifications for the TCP/IP based protocol standard ANETP.

#### Abstract

This document describes ANETP, a protocol for sending, and receiving data via slow and inconsistent PPP links.

#### 1. Rationale and Scope

The development of the Internet as the preferred communications device for the modern world has been a lengthy process and its growth has been a geometric acceleration linked strongly to the increasing reliance on computing systems for business and personal use.

The major problem is that the systems designed to carry Internet signalling have an inherit terrestrial dependence.

ANETP is like a bridge over which today's systems can travel until such time as they are replaced with a better system such as IPv6 <http://www.cis.ohio-state.edu/htbin/rfc/rfc2373.html>. It is a proprietary standard and at this stage it is not designed to be a widely implemented standard.

#### 1.1. Definitions

The HOST machine is on board the aircraft.

The REMOTE machine is the ground.

All connections are invoked from an aircraft (in the sky) to ground, initially.

(HOST to REMOTE).

As TCP/IP is the recognised leader in Internet and Heterogenous networks alike, and since PPP is the preferred analogue (serial) connection for TCP/IP and the intended environment for ANETP is such an environment, it is logical that we use TCP/IP as the underlying transport layer. It is a prerequisite for ANETP that both ends of any ANETP connection are TCP/IP ready, and a PPP link has been established.

#### 2. ANETP Protocol

The ANETP protocol is built on top of TCP/IP. Once a PPP connection has been established, Initial Protocol negotiation can begin. Once a transaction cycle has been completed, the cycle will begin again without a disconnect cycle, in a ping pong manner, unlike all other protocols.

It is assumed that the client and server will always swap at the end of a transaction. In addition the transaction cycle is not a static server client relationship. A connection, although invoked by the HOST, can be overridden by the REMOTE. In fact, unlike traditional HOST connect/HOST disconnect command hierarchy, the REMOTE machine is the overriding system in all connections.

### 2.1 Code Response Library

200-300 Status OK

300-400 Status OK (size of previous transaction)

500-600 ERROR Status

600-700 ERROR Status (size of previous transaction)

#### 2.1.2 Examples

200 Welcome

300 Block

400 Send 1 ID

500 Data path interrupted

600 Incomplete 1 (520)

700 Received

### 2.2 ANETP Initial Negotiation

#### 2.2.2. The Header

The HOST machine connects to the REMOTE machine and responds with a header. The header is designed to allow for quick identification of REMOTE machines, time/date, ID and version of ANETP. For example,

200 Welcome to ANETP/1.0 ID:#### SEQ:#### Tue, 3 Feb 1998 12:14:01

+1100 ^ Version ^ ServerID ^ Trans Seq. ^

Date ^ GMT

#### 2.2.3 The Response

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The Remote machine will respond with either a 300 response or an overriding 200. The 200 override may continue with a 200 and counter 200 until the REMOTE has issued the same 200 set twice.

A 300 response is used to set the block size and number of blocks.

A 200 response reverses the direction of the connection, and the cycle starts as at

#### 2.2.2. For example:

300 Block 1024 Blocks 19 Total 19100 SEQ

SEQ is as above

#### 2.2.4 The Counter

A counter response of a 300 code can be used to override the block size but not the transaction total. This may continue with a 300 and counter 300 until the REMOTE has issued the same 300 set twice. This allows for the ground system to override any block settings. For example,

300 Block 512 Blocks 34 Total 19100 SEQ

If the 300 is identical then data transaction begins next.

### 3. Send data

#### 3.1 Start cycle

The data cycle begins with a 400, e.g.

400 Send BLOCK SEQ SIZE REMAINING

^ Block # ^ Block size in bytes

^ SEQ TTranscation ID

^ Blocks remaining.

NO OVERRIDE IS POSSIBLE at this stage.

#### 3.2 Data

Data is sent as a zipped binary data stream.

#### 3.3 Response

700 Received BLOCK SEQ SIZE

^ Block # ^ Block size in bytes

^ SEQ TTranscation ID.

#### 3.4 Timeout or disconnect

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In the event that data is incomplete or times out the HOST machine will force a PPP reconnect. The cycle will recommence from the block that was last fully sent / received.

300 Block 1024 Blocks 19 Total 19100 SEQ

The initial 300 is the same for even a partial session, however BLOCKS and BLOCK size

may be altered to allow for connection improvements.

400 Send BLOCK SEQ SIZE REMAINING

^ Block # ^ Block size in bytes

^ SEQ T Ransaction ID.

^ Blocks remaining.

BLOCK number is the block number that was dropped. Thus the session continues from where it left off.

#### Disconnect

A permanent disconnect occurs when three 200s are sent in a row such an escape sequence indicates that neither HOST or REMOTE wishes to send data.

## CLAIMS:

1. A system for transmitting electronic data between a computer terminal on an aircraft and a terrestrial base station, the system including:
  - a server mounted upon or within the aircraft for communicating with the computer terminal wherein the terminal is disposed remotely from the server; and
  - 5 a terrestrial base station for selectively communicating with the server to allow the data to be passed between the base station and the terminal.
2. A system according to claim 1 wherein the base station communicates with the server via a link selected from one or a combination of: one or more wireless links; and one or more wire links.
- 10 3. A system according to claim 1 wherein the base station communicates with the server via one or more wireless links, each of those wireless links being selected from the group comprising: a satellite link; a cellular telephone link; a microwave link; a NATS compatible link; and another communication system.
- 15 4. A system according to claim 2 or claim 3 wherein the selection of the or each link is dependent upon one or more of: the availability of each link; the relative cost of each link; and the relative speed of each link.
5. A system according to any one of the preceding claims including a plurality of spaced apart terrestrial base stations and the server communicates selectively with one 20 or more of the stations.
6. A system according to claim 5 wherein the base station with which the server selectively communicates is dependent upon the position of the aircraft with respect to the stations.

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7. A system according to any one of the preceding claims wherein the server communicates with a plurality of remotely disposed computer terminals located on the aircraft for allowing communication of the electronic data between the base station and the respective terminals.
- 5 8. A system according to claim 1 wherein the terrestrial base station selectively communicates with an Internet service provider (ISP) to collect the electronic data and provide it to the terminal via the server.
9. A system according to any one of the preceding claims wherein the data is communicated between the server and the terminal using one or more of: SMTP;
- 10 HTTP; POP3; or IMAP.
10. A system according to claim 8 wherein the data is collected from the ISP and delivered to the base station using POP3 or IMAP.
11. A system according to any one of the preceding claims wherein the base station includes means for providing a first signal indicative of the structure of the data
- 15 and the terminal includes means for generating a second signal in response to the first signal confirming that the data is to be transmitted to the terminal.
12. A system according to claim 11 wherein the first signal is indicative of one or more of the following: text; file type; attachments; graphics; backgrounds; and the like.
- 20 13. A system according to claim 11 or claim 12 wherein the second signal confirms to the base station which portions of the data are to be transmitted.
14. A system according to any of the preceding claims wherein the base station stores electronic data to be transmitted from the base station to the server, and the

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server stores electronic data to be transmitted from the server to the base station, the server and base station communicating with each other intermittently.

15. A system according to any one of the preceding claims wherein the server includes a database of information, the database being updated periodically by transmission of electronic data from the base station to the server.
16. A system according to claim 15 wherein the server allows the terminals to access the database.
17. A system according to claim 16 wherein the terminals access the database with a web browser.
18. A system according to claim 7 wherein the server communicates with that base station which is nearest to the aircraft.
19. A system according to claim 18 wherein the server determines which of the base stations is nearest by determining the current location of the aircraft.
20. A system according to claim 18 wherein the server communicates with one only of the base stations.
21. A system according to claim 20 wherein the server communicates with selectively with more than one of the base stations, the selection being made on the basis of the available remaining capacity of the respective base stations.
22. A system according to claim 20 wherein the server communicates selectively with one of the base stations, the selection being made on the basis of the least expensive communication route that is made available by the respective base stations.
23. A system according to any one of the preceding claims wherein the computer terminal is suitable for either browsing the Internet or sending and retrieving Email.

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24. A system according to claim 23 wherein the terminal is a portable personal computer.
25. A system according to claim 23 wherein the terminal is a PDA.
26. A method for transmitting electronic data between a computer terminal on an aircraft and a terrestrial base station, the method including the steps of:
  - providing a server mounted upon or within the aircraft for communicating with the computer terminal wherein the terminal is disposed remotely from the server; and
  - selectively communicating between a terrestrial base station and the server to allow the data to be passed between the base station and the terminal.
- 10 27. A method according to claim 26 wherein the base station communicates with the server via a link selected from one or a combination of: one or more wireless links; and one or more wire links.
28. A method according to claim 26 wherein the base station communicates with the server via one or more wireless links, each of those wireless links being selected
- 15 from the group comprising: a satellite link; a cellular telephone link; a microwave link; a NATS compatible link; and another communication system.
29. A method according to claim 27 or claim 28 wherein the selection of the or each link is dependent upon one or more of: the availability of each link; the relative cost of each link; and the relative speed of each link.
- 20 30. A method according to any one of claims 26 to 29 including the steps of providing a plurality of spaced apart terrestrial base stations and allowing the server to communicate selectively with one or more of the stations.

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31. A method according to claim 30 wherein the base station with which the server selectively communicates is dependent upon the position of the aircraft with respect to the stations.

32. A method according to any one of claims 26 to 31 wherein the server  
5 communicates with a plurality of remotely disposed computer terminals located on the aircraft for allowing communication of the electronic data between the base station and the respective terminals.

33. A method according to claim 26 wherein the terrestrial base station selectively  
communicates with an Internet service provider (ISP) to collect the electronic data and  
10 provide it to the terminal via the server.

34. A method according to any one of claims 26 to 33 wherein the data is  
communicated between the server and the terminal using one or more of: SMTP;  
HTTP; POP3; or IMAP.

35. A method according to claim 33 wherein the data is collected from the ISP and  
15 delivered to the base station using POP3 or IMAP.

36. A method according to any one of claims 26 to 35 wherein the base station  
provides a first signal indicative of the structure of the data and the terminal generates  
a second signal in response to the first signal confirming that the data is to be  
transmitted to the terminal.

20 37. A method according to claim 36 wherein the first signal is indicative of one or  
more of the following: text; file type; attachments; graphics; backgrounds; and the  
like.

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38. A method according to claim 36 or claim 37 wherein the second signal confirms to the base station which portions of the data are to be transmitted.
39. A method according to any of the preceding claims wherein the base station stores electronic data to be transmitted from the base station to the server, and the
- 5 50 server stores electronic data to be transmitted from the server to the base station, the server and base station communicating with each other intermittently.
40. A method according to any one of claims 26 to 39 wherein the server includes a database of information, the database being updated periodically by transmission of electronic data from the base station to the server.
- 10 41. A method according to claim 40 wherein the server allows the terminals to access the database.
42. A method according to claim 41 where the terminals access the database with a web browser.
43. A method according to claim 32 wherein the server communicates with that
- 15 55 base station which is nearest to the aircraft.
44. A method according to claim 43 wherein the server determines which of the base stations is nearest by determining the current location of the aircraft.
45. A method according to claim 43 wherein the server communicates with one only of the base stations.
- 20 46. A method according to claim 45 wherein the server communicates with selectively with more than one of the base stations, the selection being made on the basis of the available remaining capacity of the respective base stations.

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47. A method according to claim 45 wherein the server communicates selectively with one of the base stations, the selection being made on the basis of the least expensive communication route that is made available by the respective base stations.
48. A method according to any one of claims 26 to 47 wherein the computer terminal is suitable for either browsing the Internet or sending and retrieving Email.
49. A method according to claim 48 wherein the terminal is a portable personal computer.
50. A method according to claim 48 wherein the terminal is a PDA.
51. An aircraft computer communication system including:
  - 10 a first port and a second port located on the aircraft for allowing the establishment of a first network node and a second network node respectively; and a network located on the aircraft for linking the first node and the second node and allowing communication between the first node and the second node.
  52. A system according to claim 51 wherein the network includes a telephone system and the second node is connected to the telephone system.
  53. A system according to claim 52 wherein the second node is connected to the telephone system with a modem connection.
  54. A system according to any one of claims 51 to 53 wherein the first node is connected to the telephone system with a CEPT-E1 connection.
  - 20 55. A system according to claim 54 wherein the CEPT-E1 connection complies with an ARINC 746, attachment 11 radio bearer system interface.
  56. A network according to any one of claims 51 to 55 wherein the first and the second network nodes are a server and a computer terminal respectively.

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57. An aircraft computer network including:

a network hub located on an aircraft for allowing the transfer of first electronic

data from the network to a base station;

a first port and a second port located on the aircraft for allowing the

5 establishment of a first network node and a second network node respectively, wherein  
the nodes transfer respective second and third electronic data to the network via the  
hub such that the first data includes selected portions of the second data.

58. A network according to claim 57 wherein the second data includes selected  
portions of the third data.

10 59. An aircraft computer network including:

a network hub located on an aircraft for allowing the transfer of first electronic

data from a base station to the network;

a first port and a second port located on the aircraft for allowing the

establishment of a first network node and a second network node respectively, wherein  
15 the network transfer respective second and third electronic data to the nodes via the  
hub such that the second data includes selected portions of the first data.

60. A network according to claim 59 wherein the third data includes selected  
portions of the second data.

61. A method of communicating on an aircraft, the method including the steps of:

20 locating a first port and a second port on the aircraft for allowing the  
establishment of the first node and the second node respectively;

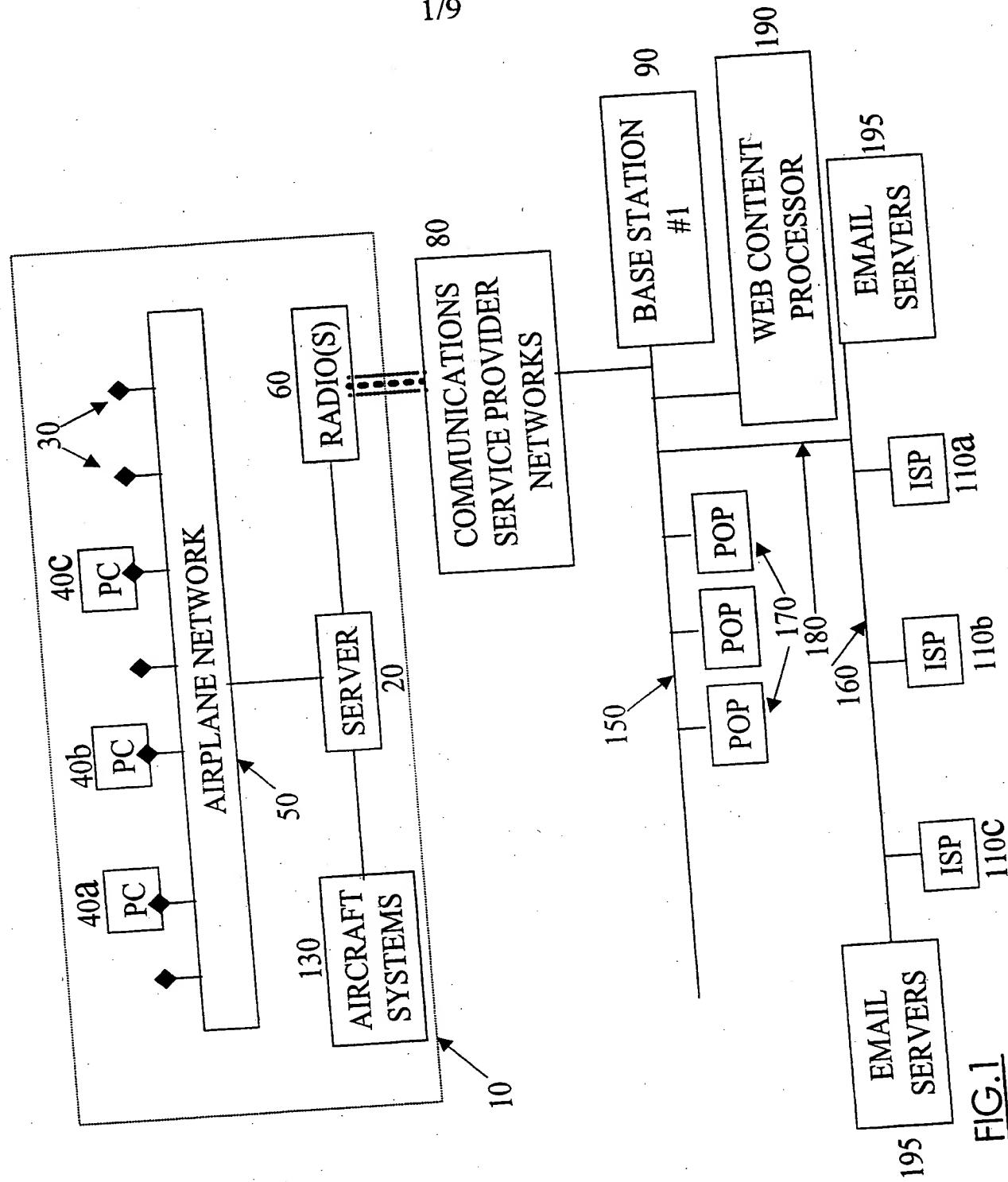
locating a network on the aircraft for linking the first node and the second node  
and allowing communication between the first node and the second node.

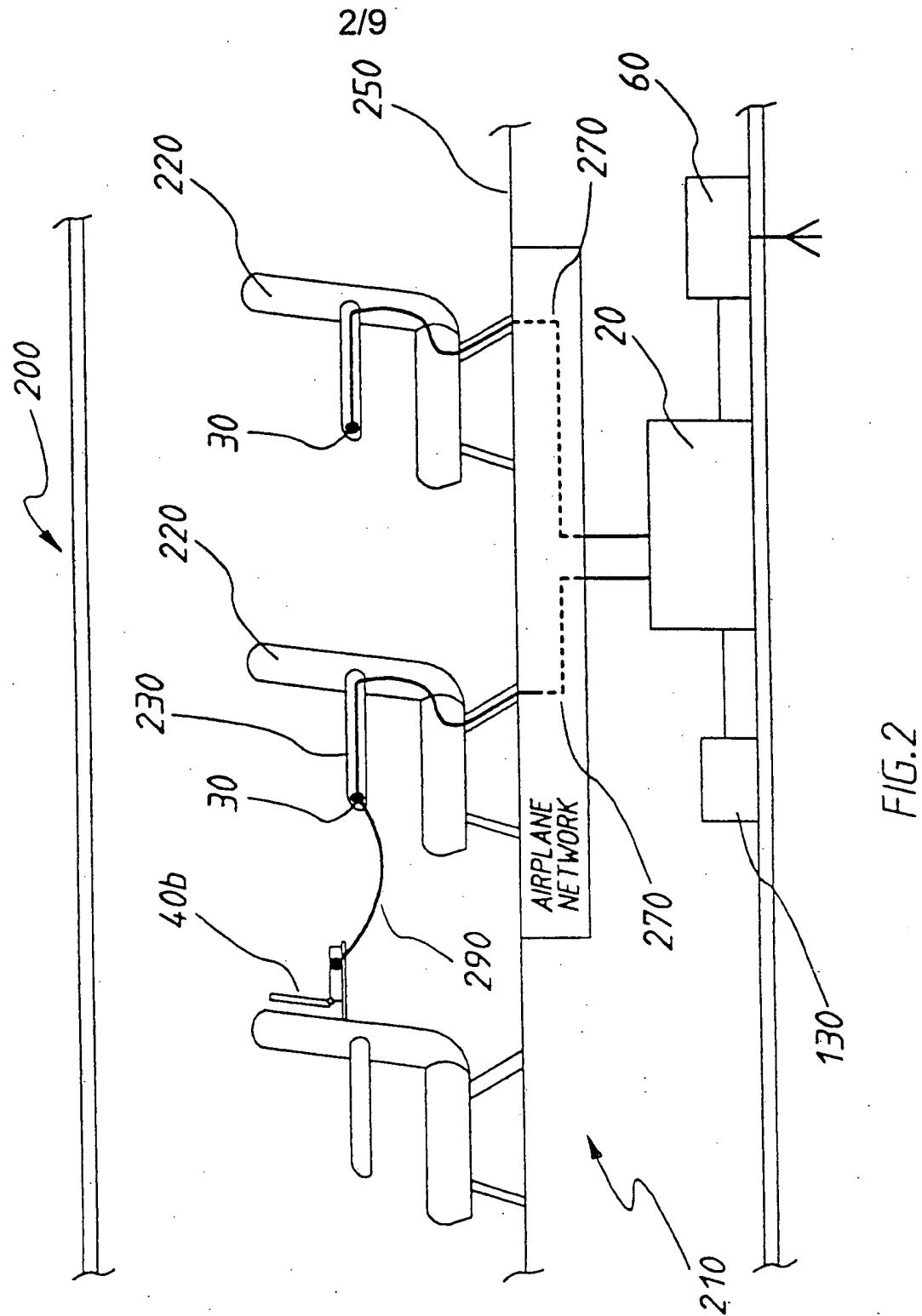
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62. A method according to claim 61 wherein the network includes a telephone system and the second node is connected to the telephone system.
63. A method according to claim 62 wherein the second node is connected to the telephone system with a modem connection.
- 5 64. A method according to any one of claims 61 to 63 wherein the first node is connected to the telephone system with a CEPT-E1 connection.
65. A method according to claim 64 wherein the CEPT-E1 connection complies with an ARINC 746, attachment 11 radio bearer system interface.
66. A method according to any one of claims 61 to 65 wherein the first and the 10 second network nodes are a server and a computer terminal respectively.
67. A method of communicating between a first node and a second node of an aircraft computer network, the method including the steps of:
  - locating a network hub on an aircraft for allowing the transfer of first electronic data from the network to a base station;
  - 15 locating a first port and a second port on the aircraft for allowing the establishment of the first network node and the second network node respectively, wherein the nodes transfer respective second and third electronic data to the network via the hub such that the first data includes selected portions of the second data.
  68. A method according to claim 67 wherein the second data includes selected 20 portions of the third data.
  69. A method of communicating between a first node and a second node of an aircraft computer network, the method including the steps of:

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- locating a network hub on an aircraft for allowing the transfer of first electronic data from a base station to the network;
- locating a first port and a second port on the aircraft for allowing the establishment of a first network node and a second network node respectively, wherein
- 5 the network transfer respective second and third electronic data to the nodes via the hub such that the second data includes selected portions of the first data.
70. A method according to claim 69 wherein the third data includes selected portions of the second data.
71. A system for transmitting electronic data between a computer terminal on an
- 10 aircraft and a terrestrial base station as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings.
72. A method for transmitting electronic data between a computer terminal on an aircraft and a terrestrial base station substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying
- 15 drawings.
73. An aircraft computer communications system substantially as herein described with reference to any one of the embodiments of the invention illustrated in the accompanying drawings.
74. A method of communicating on an aircraft substantially as herein described
- 20 with reference to any one of the embodiments of the invention illustrated in the accompanying drawings.

FIG.1



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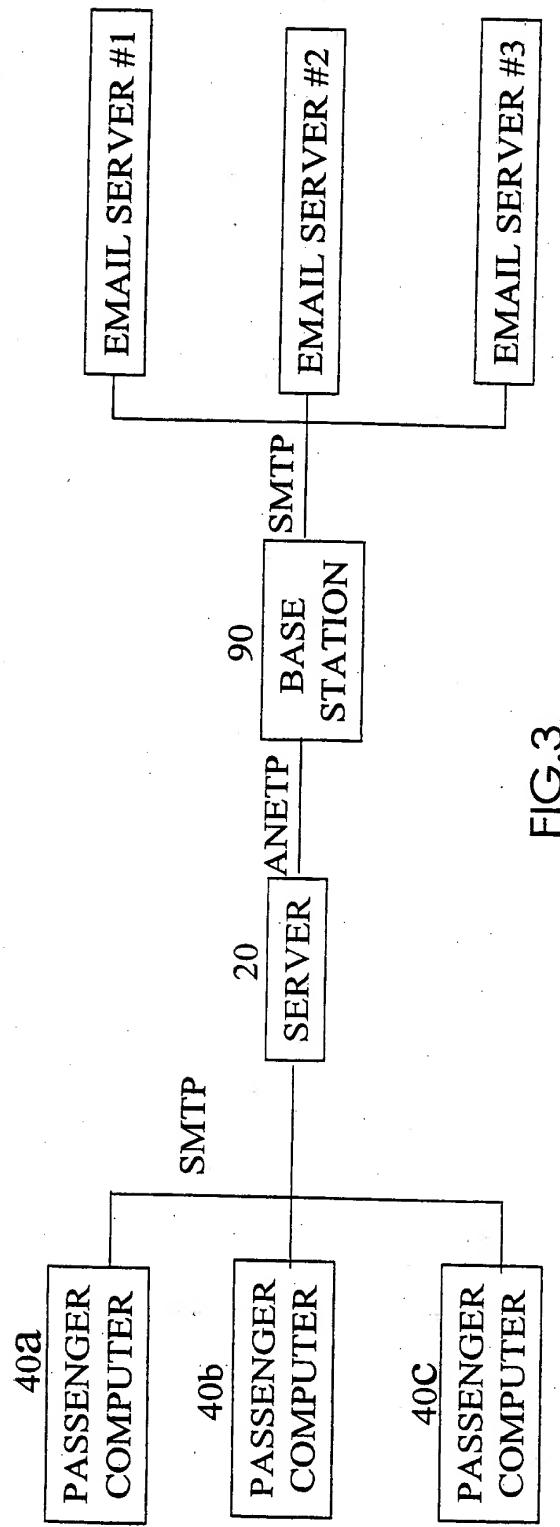


FIG.3

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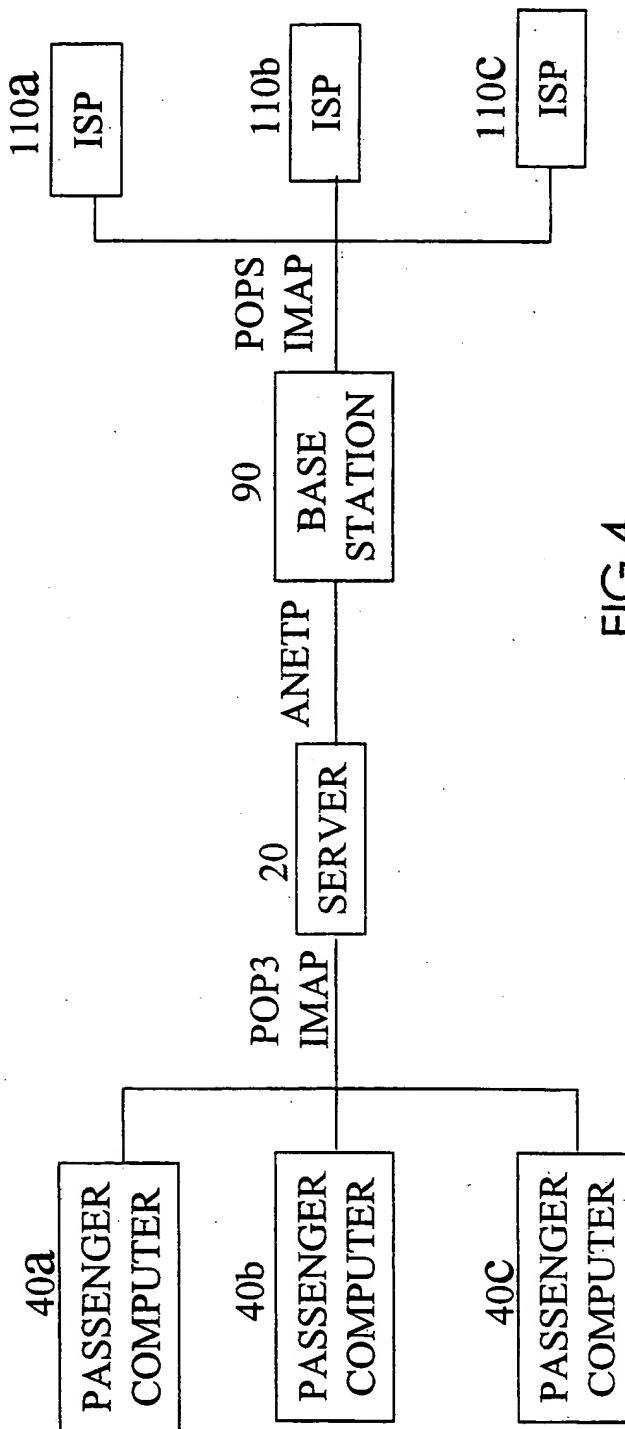
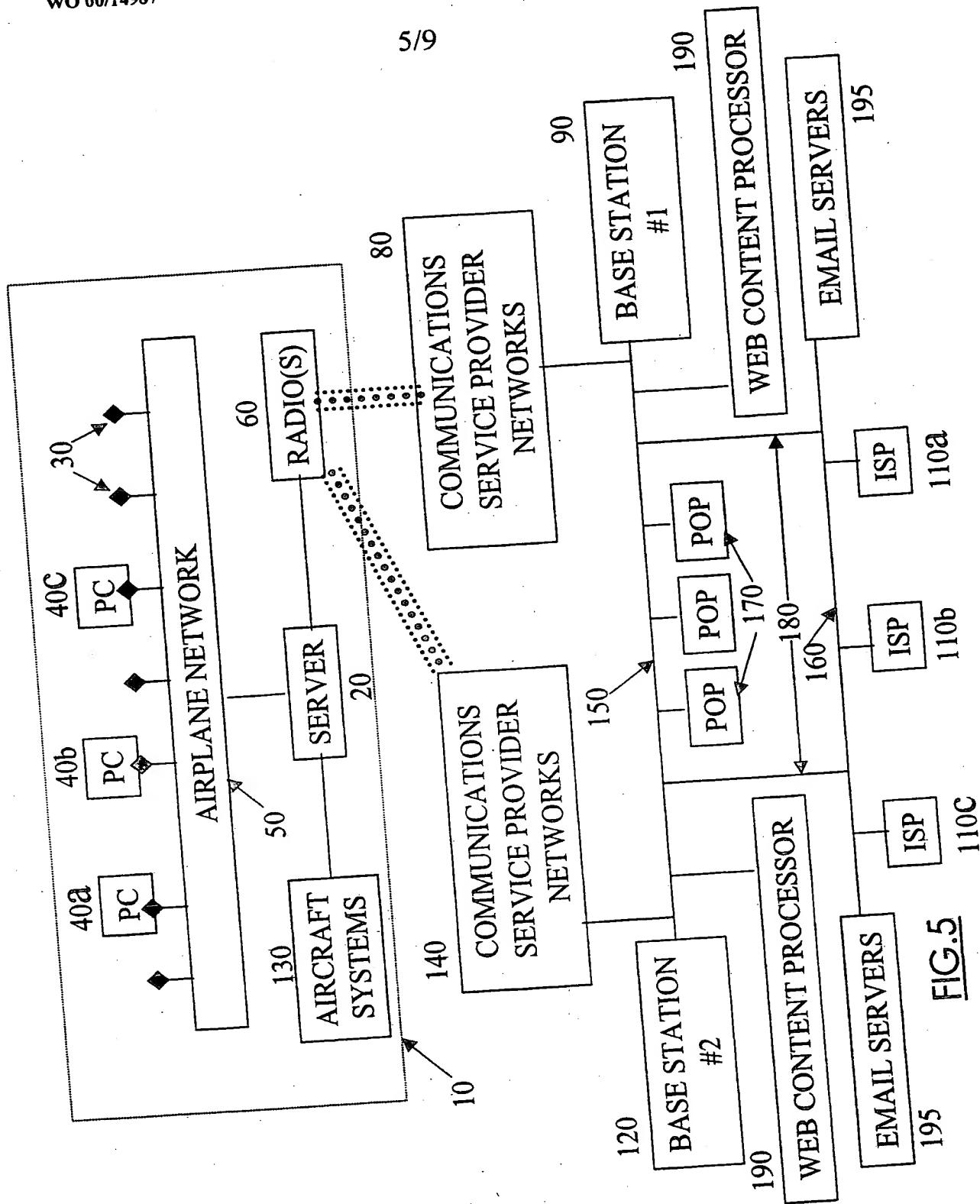
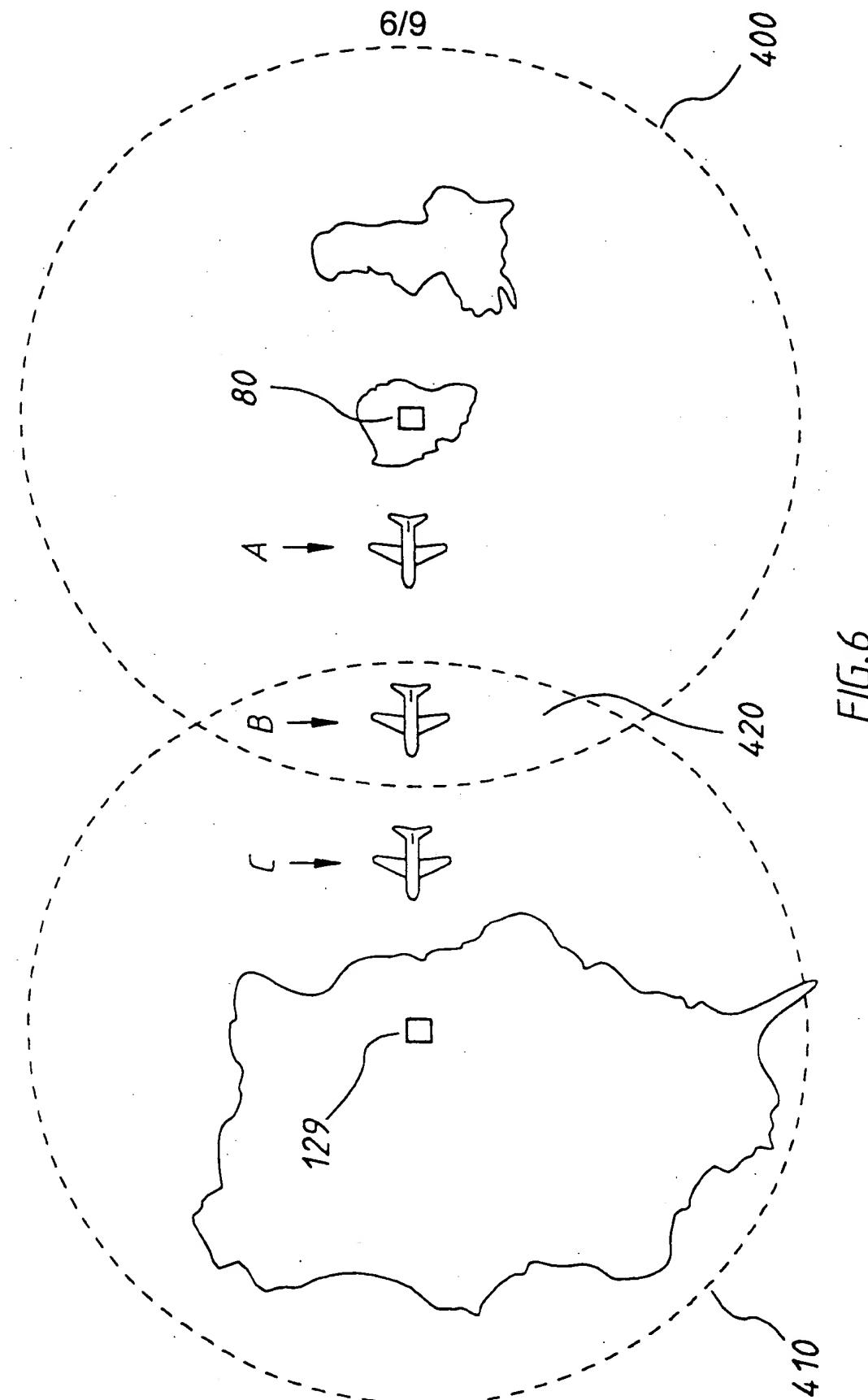


FIG.4

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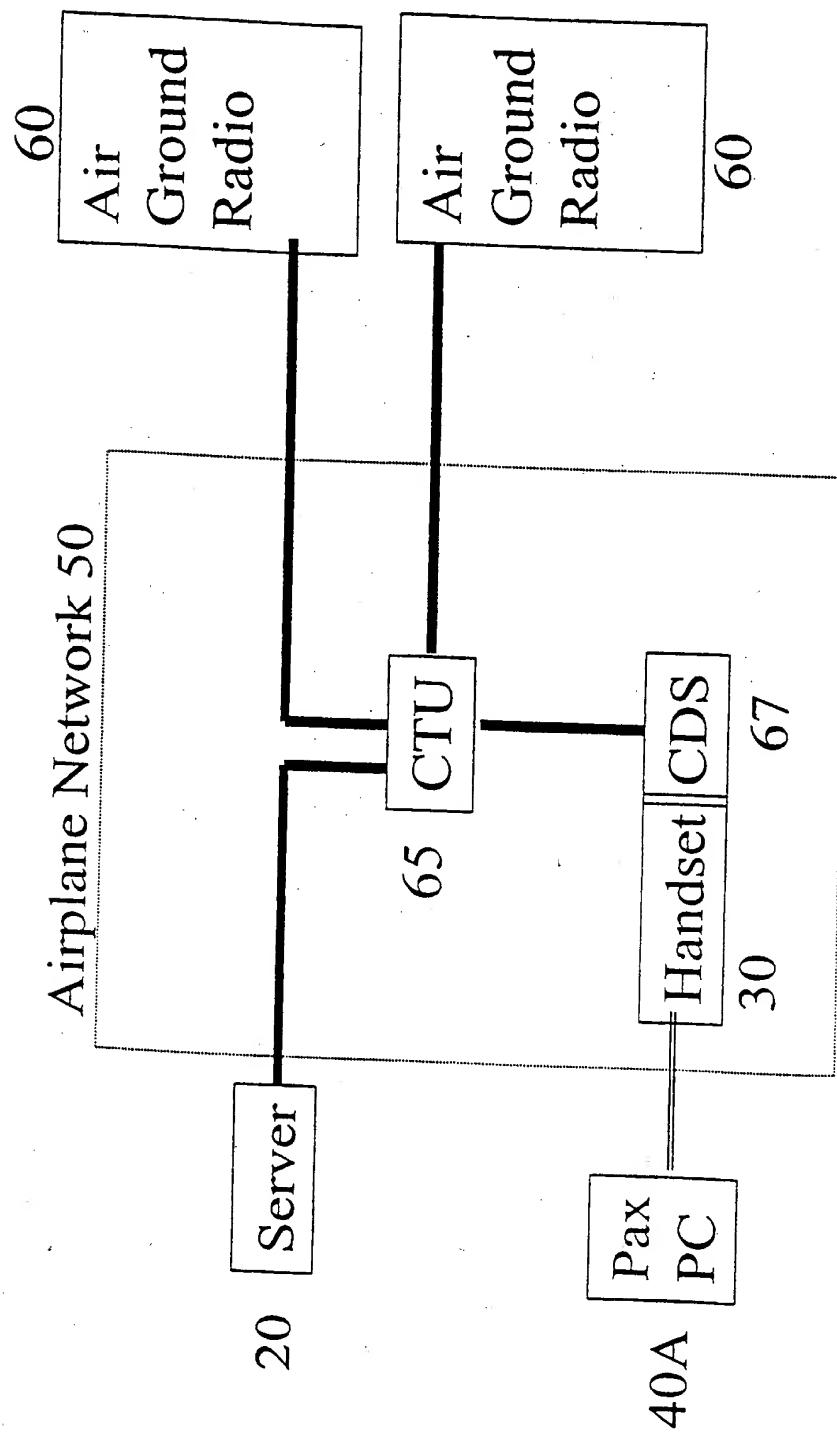


Figure 7 - Modem Airplane Network

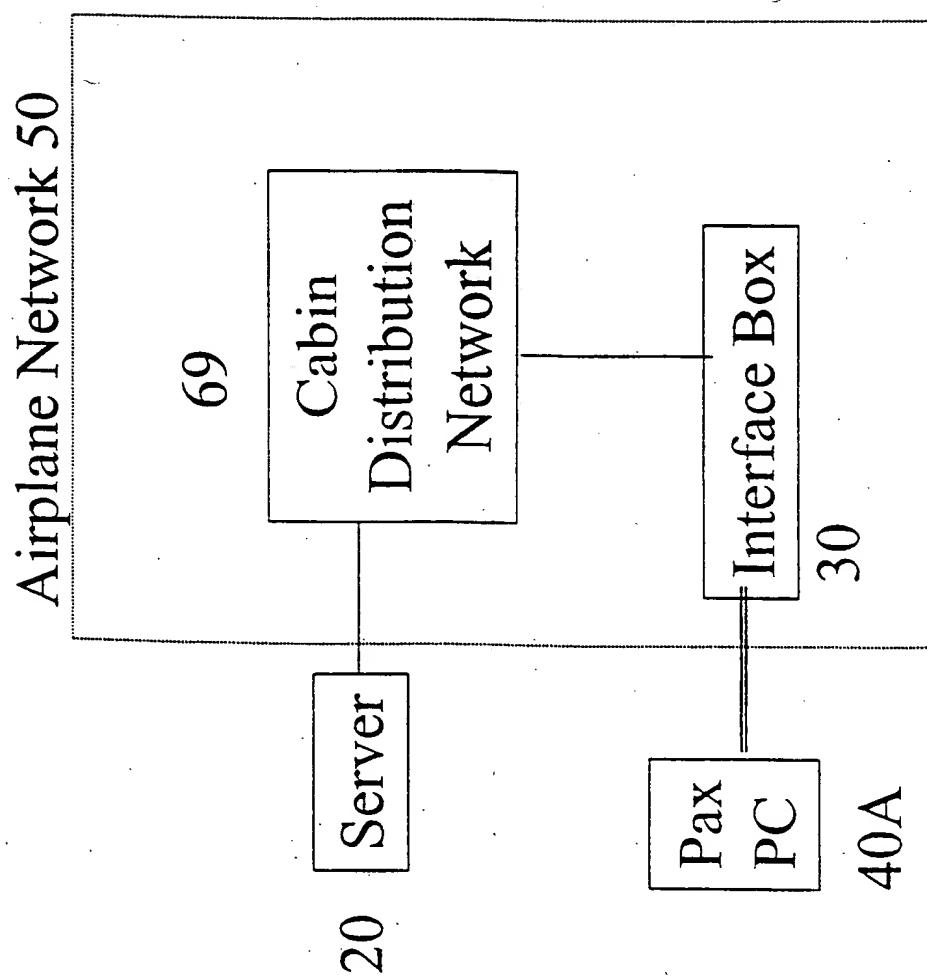


Figure 8 - RS232, USB, IEEE 1394 Airplane Network

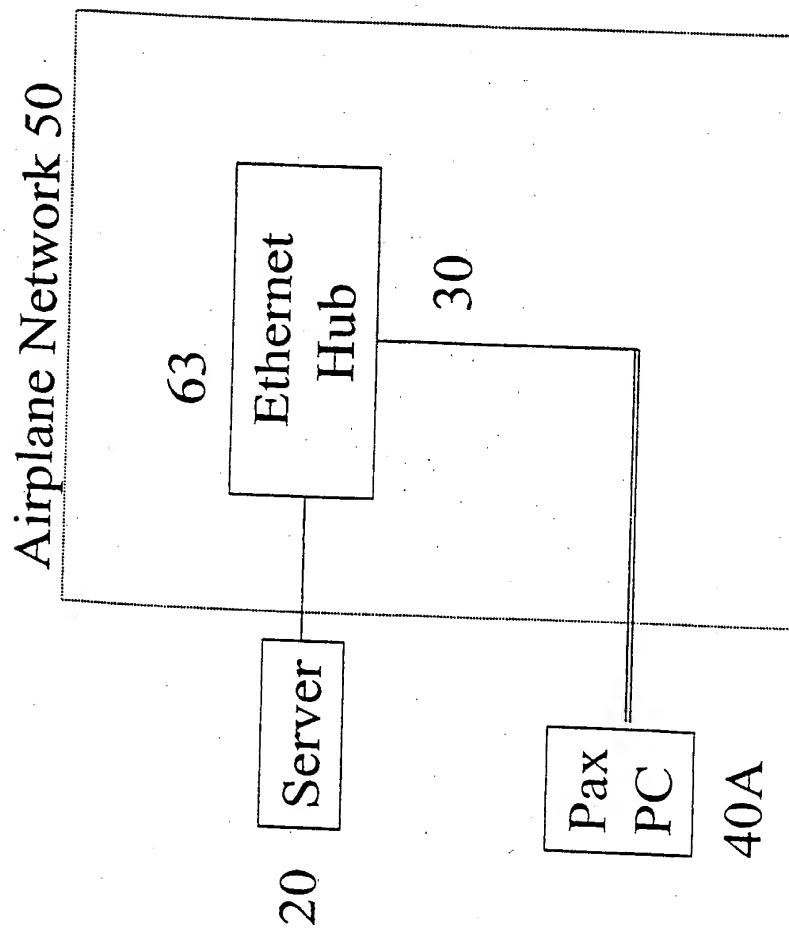


Figure 9 - Ethernet Airplane Network

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU 99/00737

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98/26521 A (TELEFONAKTIEBOLAGET LM ERICSSON) 18 June 1998 Whole document	1-70
A	EP 837 567 A (THE BOEING COMPANY) 22 April 1998 Whole document	1-70
A	WO 96/02093 A (QUALCOMM INCORPORATED) 25 January 1996 Whole document	1-70
A	WO 96/02094 A (QUALCOMM INCORPORATED) 25 January 1996 Whole document	1-70

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/AU 99/00737

## A. CLASSIFICATION OF SUBJECT MATTER

Int Cl<sup>6</sup>: H04Q 7/38; H04B 7/204; H04L 12/28

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
IPC H04Q, H04B, H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
WPAT

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	EP 890 907 A (ICO Services Ltd.) 13 January 1999 Whole document	1-70
X	GB 2 317 074 A (I-CO Global Communications (Holdings) Limited) 11 March 1998 page 33 line 19-page 34 line 18, fig. 10	61-63

Further documents are listed in the continuation of Box C

See patent family annex

## \* Special categories of cited documents:

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Date of the actual completion of the international search  
06 October 1999

Date of mailing of the international search report

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Name and mailing address of the ISA/AU  
AUSTRALIAN PATENT OFFICE  
PO BOX 200  
WODEN ACT 2606  
AUSTRALIA  
Facsimile No.: (02) 6285 3929

Authorized officer

J. LAW  
Telephone No.: (02) 6283 2179

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
PCT/AU 99/00737

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
EP	890 907	JP	11-127 097
GB	2 317 074	EP	828 354
		JP	10-155 178
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EP	837 567	JP	10-150 401
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		CN	1 152 379
		EP	770 287
		FI	970084
		US	5 519 761
WO	96/02094	AU	29672/95
		US	5 559 865

END OF ANNEX

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